Improving Nutritional Value of Diet by Introducing Diet Diversity through Local Nutritional Solution in Rural Households

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Acronyms

BMI	Body Mass Index
DD	Diet Diversity
DLHS	District Level Household survey
FAO	Food and Agriculture Organization
GHI	Global Hunger Index
GIT	Gastro Intestinal Track
HDDS	Household Dietary Diversity Score
HH	Household
HHs	Households
ICMR	Indian Council of Medical Research
IGIDR	Indra Gandhi Institute for Development Research
IFPRI	International Food Policy Research Institute
MUAC	Mid Upper Arm Circumference
NFHS	National Family and Health Survey
NNMB	National Nutrition Monitoring Bureau
NOS	Numbers
NPNL	Non- Pregnant and Non- Lactating
NSSO	National Sample Survey Organization
RDA	Recommended Dietary Allowance
RSoC	Rapid Survey on Children
UP	Uttar Pradesh
WHO	World Health Organization

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1.0 INTRODUCTION

"Human needs a wide range of nutrients to lead a healthy and active life. The required nutrients for different physiological groups can only be derived from a well balanced diet. Components of the diet must be chosen judiciously to provide all the nutrients to meet the human requirements in proper proportions for the different physiological activities. The amount of each nutrient needed for an individual depends upon his/her age, body weight and physiological status. Adults need nutrients for maintenance of constant body weight and for ensuring proper body function. Infants and young children grow rapidly and require nutrients not only for maintenance but also for growth. They require relatively more nutrients (2-3 times) per kg body weight than adults. In physiological conditions like pregnancy and lactation, adult woman needs additional nutrients to meet the demand for fetal growth and maternal tissue expansion in pregnancy and milk secretion during lactation. These extra intakes of nutrients are essential for normal growth of infants in uterus and during early post-natal life" as per the Recommended Dietary Allowance for Indians (RDA), 2010.

1.1. Nutrient Requirement:

Dietary standards, regardless of the name they go by – Recommended Dietary Allowances, Recommended Nutrient Intakes, Recommended Daily Amounts of Nutrients, or Safe Intakes of Nutrients – are the average daily amounts of essential nutrients estimated, on the basis of available scientific knowledge, to be sufficiently high to meet the physiological needs of practically all healthy persons in a group with specified characteristics.

Based on the amount of the nutrients that each person needs to consume on a daily basis, these nutrients are categorized into two groups. These are macronutrients (Protein, Carbohydrate, Fat), which should be consumed in fairly large amounts, and micronutrients (Vitamins and minerals), which are only required in small amounts.

(I) Carbohydrates:

Carbohydrates can be grouped into two categories: simple and complex. Simple carbohydrates are sugars whereas complex carbohydrates consist of starch and dietary fiber. Carbohydrate provides about 4 kcal (kcal = kilocalories = Calories) per gram (except for fiber) and is the energy that is used first to fuel muscles and the brain. Soluble fiber (fruits, legumes, nuts, seeds, brown rice, and oat, barley and rice bran) lowers blood cholesterol and helps to control blood sugar levels while providing very little energy. Insoluble fiber (wheat and corn bran, whole-grain breads and cereals, vegetables, fruit skins, nuts) doesn't provide any calories. It helps to alleviate digestive disorders like constipation or diverticulitis and may help prevent colon cancer. Most calories (55-60%) should come from carbohydrates. Sources of carbohydrates include grain products such as breads, cereals, pasta, and rice as well as fruits and vegetables.

(II) Protein:

Protein from food is broken down into amino acids by the digestive system. These amino acids are then used for building and repairing muscles, red blood cells, hair and other tissues, and for making hormones. Adequate protein intake is also important for a healthy immune system. Protein is a source of calories (4 kcal per gram), it will be used for energy if not enough carbohydrate is available due to skipped meals, heavy exercise etc. Main sources of protein are animal products like meat, fish, poultry, milk, cheese and eggs and vegetable sources like legumes (beans, lentils, dried peas, nuts) and seeds.

(III) Fat:

The fat in food includes a mixture of saturated and unsaturated fat. Animal-based foods such as meats and milk products are higher in saturated fat whereas most vegetable oils are higher in unsaturated fat. Compared to carbohydrate and protein, each gram of fat provides more than twice the amount of calories (9 kcal per gram). Nevertheless, dietary fat does play an important role in a healthy diet. Fat maintains skin and hair, cushions vital organs, provides insulation, and is

necessary for the production and absorption of certain vitamins and hormones. Nutrition guidelines state that Canadians should include no more than 30% of energy (calories) as fat as and no more than 10% of energy as saturated fat.

(IV) Water:

Water is basic requirement of live, without water cannot live more than a few days. Almost every part of the body contains large amounts of water, that a 50 kg adult contains about 31 liters of water and a one year old; 10 kg child contains nearly 8 liters of water.

An adult needs about 2–3 liters of water each day. For the body to make cells and fluids such as tears, digestive juices and breast milk, for the body to make sweat for cooling itself, for essential body processes — most take place in water, for keeping the lining of the mouth, intestine, eyelids and lungs wet and healthy, for the production of urine this carries waste from the body.

(VI) Vitamins:

Vitamins are groups of related substances present in small amounts in food stuffs and are necessary for the body to function normally. Vitamins are also called protective foods. They are grouped together because, as their name implies, they are a vital factor in the diet.

Vitamins are classified into two groups:

(a) **Fat soluble vitamins** (vitamins A, D, E and K) are soluble in fats and fat solvents. They are insoluble in water. So these are utilised only if there is enough fat in the body.

(b) **Water soluble vitamins** (vitamins B and C, and folic acid) are soluble in water and so they cannot be stored in the body.

The best sources of micronutrients in diets are fruits and vegetables. These two food groups contain essential vitamins and minerals. Animal sources of foods are also both good sources of

micronutrients. However, an adequate micronutrient intake can only be achieved through sufficient intake of a balanced diet that includes plenty of fruits and vegetables.

Table 1.1 Functions and sources of vitamins:

Vitamins	**Function**	**Food sources**
Vitamin A	Night vision Healing epithelial cells Normal development of teeth and bones	Breast milk, tomatoes, cabbage, pumpkins, mangoes, papaya, carrots, liver, kidney, egg yolk, milk, butter and cheese cream.
Vitamin D	Needed for absorption of calcium from small intestines Calcification of the skeleton	Ultra violet light from the sun, eggs, butter, fish, fortified oils, fats and cereals.
Vitamin K	For blood clotting	Green leafy vegetables, fruits, cereals, meat and dairy products.
B complex	Metabolism of carbohydrates, proteins and fats	Milk, egg yolk, liver, kidney and heart, whole grain cereals, meat, whole bread, fish and bananas.
Vitamin C	Prevention of scurvy Aiding wound healing Assisting absorption of iron	Fresh fruits (oranges, banana, mango, grapefruits, lemons, potatoes), and vegetables (cabbage, carrots, pepper, tomatoes) and breast milk.

(VII) Minerals:

These essential nutrients, those that body needs but cannot produce; include the inorganic substances found in foods known as minerals.

Table 1.2 Function and sources of minerals:

Minerals	**Function**	**Food sources**
Calcium	Gives bones and teeth rigidity and strength, nerve transmissions, muscle function including that of the heart and secretion of hormone.	Milk, cheese and dairy products, foods fortified with calcium (e.g. flour), cereals, eggs, fish cabbage.
Potassium	Vital to maintaining a normal heart rhythm, build proteins, break down and use carbohydrates, maintain the pH balance of the blood and support normal growth.	Beef, fish, chicken, cantaloupe, potatoes, tomatoes and lima beans
Magnesium	Support biochemical reactions, muscle and nerve function, and heart beating regularly, builds strong bones and boosts immunity.	Beans, nuts, whole grains and green vegetables serve as good sources of magnesium.
Phosphorus.	Building strong bones and teeth, producing proteins the body needs and repairing cells	Dairy foods, meat and whole grains
Chloride.	Production of digestive juices in the stomach	With the high salt content of foods,
Iron	Formation of hemoglobin	Meat and meat products, eggs, bread, green leafy vegetables, pulses, fruits
Iodine	For normal metabolism of cells	Iodised salt, sea vegetables, yogurt, cow's milk, eggs, and cheese, Fish; plants grown in iodine-rich soil

Zinc	For children to grow and develop normally; for wound healing	Maize, fish, breast milk, meat, beans

(VIII) Energy Requirements:

The body needs energy for maintaining body temperature and metabolic activity and for supporting physical work and growth. The energy allowances recommended are designed to provide enough energy to promote satisfactory growth in infants and children and to maintain constant appropriate body weight and good health in adults. The factors which influence energy needs are age, body size, physical activity and in to some extent, climate and altered physiological status such as pregnancy and lactation.

Table 1.3 Summary of RDA for Indians (2010)

Group	Particulars	Body Wt. kg	Netenergy kcal/d	Protein g/d	Visible Fat g/d	Calcium mg/d	Iron mg/d	Vit.Ag/d		Thiamine mg/d	Riboflavin mg/d	Niacin equivalent mg/d	Pyridoxine mg/d	Ascorbic Acid mg/d	Dietary folate g/d	Vit.B_{12} g/d	Magnesium mg/d	Zinc mg/d
								Retinol	-carotene									
Man	Sedentary work	60	2320	60.0	25	600	17	600	4800	1.2	1.4	16	2.0	40	200	1.0	340	12
	Moderate		2730		30					1.4	1.6	18						
	Heavy work		3490		40					1.7	2.1	21						
Woman	Sedentary work	55	1900	55.0	20	600	21	600	4800	1.0	1.1	12	2.0	40	200	1.0	310	10
	Moderate		2230		25					1.1	1.3	14						
	Heavy Work		2850		30					1.4	1.7	16						
	Pregnant wom		+350	82.2	30	1200	35	800	6400	+0.2	+0.3	+2	2.5	60	500	1.2		12
	Lactation 0-6		+600	77.9	30	1200	25	950	7600	+0.3	+0.4	+4	2.5	80	300	1.5		
	6-		+520	70.2	30					+0.2	+0.3	+3	2.5					
Infants	0- 6months	5.4	92 kcal/kg/d	1.16 g/kg/d	--	500	46	350	---- 28	0.2	0.3	710 g/kg	0.1	25	25	0.2	30	---
	6– 12months	8.4	80 kcal/kg/d	1.69 g/kg/d	19		05			0.3	0.4	650 g/kg	0.4				45	---
Children	1-3years	12.9	1060	16.7	27	600	09	400	3200	0.5	0.6	8	0.9	40	80	0.2-1.0	50	5
	4-6years	18.0	1350	20.1	25		13			0.7	0.8	11	0.9		100		70	7
	7-9years	25.1	1690	29.5	30		16	600	4800	0.8	1.0	13	1.6		120		100	8
Boys	10-12years	34.3	2190	39.9	35	800	21	600	4800	1.1	1.3	15	1.6	40	140	0.2-1.0	120	9
Girls	10-12years	35.0	2010	40.4	35	800	27			1.0	1.2	13	1.6				160	9
Boys	13-15years	47.6	2750	54.3	45	800	32			1.4	1.6	16	2.0	40	150	0.2-1.0	165	11
Girls	13-15years	46.6	2330	51.9	40	800	27			1.2	1.4	14	2.0				210	11
Boys	16-17years	55.4	3020	61.5	50	800	28			1.5	1.8	17	2.0	40	200	0.2-1.0	195	12
Girls	16-17years	52.1	2440	55.5	35	800	26			1.0	1.2	14	2.0				235	12

Eating a varied, well-balanced diet means eating a variety of foods from each food groups daily, in the recommended amounts. It is also important to choose a variety of foods from within each food group because different foods provide different types and amounts of key nutrients.

Table 1.4 Low cost balanced diet (according to RDA- moderate worker male)

Food stuff	**g/day**
Cereals (including millets)	460
Pulses	40
Green leafy vegetables	50
Other Vegetables	100
Root and Tubers	100
Fruits	100
Milk	150 ml
Sugar	30
Oil (for Coking)	35

Table 1.5 Intakes of nutrients (nutritive value of row ingredients)

Calories (Kcal)	2738
Protein (g)	66.60
Calcium (mg)	781.60
Iron (mg)	62.20
Vitamin A (μg)	715.00
Riboflavin(mg)	1.15
Thiamine (mg)	2.45
Vitamin C (mg)	74.80
Niacin (mg)	15.66
Total Fat (g)	66.90

The amount of food stuff listed above for moderate male worker is selected according to low cost Diet to fulfill their nutritional requirement. In the same way different group have different

nutritional requirement. In this study the diet plan (Diversify Diet) will be prepared according to HH requirement. In which food are included according to availability in HH and local market.

1.2. Nutritional Scenario of India:

India is drawing the world's attention, due to its population explosion with prevailing poor health scenario due to malnutrition, under nutrition and nutritional deficiencies (Global Hunger Index-GHI2015). The incidences of infant malnutrition and iron deficiency Anemia have been increases among adolescent girls at present health scenario of India, even after implementation of various supplementary and other preventive policies (India Health Report: Nutrition, 2015).

According to recent National Family Health Survey (2013-14) Reports, 46% of preschool children and 30% of adults in India suffer from moderate and severe grades of protein-calorie malnutrition as judged by anthropometric indicators. Currently, India is in nutrition transition with 10% rural adults and 20% urban adults suffering from over nutrition leading to an emerging double burden of malnutrition.

The micronutrient inadequacy (especially iron, folic acid, niacin, vitamin C, copper, cobalt etc,) in the diet of entire households and across generations in the country is major cause of the problem (NNMB- Technical Report No. 22**).** According to the District Level Household Survey (DLHS), 2012-13 and Rapid survey of Children (RSoC), 2014 surveys have shown anemia and BMI status of Indian Women's.

Table 1.6 Anemia and BMI status of Indian woman's:

Age Group	**Anemia %**	**BMI**		
		Low	Normal	High
Adolescent girls (15-18)*	55.8	44.7	50.8	4.5

Women's (15-49) **	55.3	35.6	51.9	12.6
Pregnant women's **	58.7	----	----	----

Source**:** *RSoC, 2014, ****DLHS, 2012-13.

1.3. Nutritional status of Uttar Pradesh: "Though severe clinical forms of protein-calorie malnutrition (PCM): Kwashiorkor and Marasmus have become rare, they persist in some less developed states like Uttar Pradesh and Orissa" (RDA, 2010). National Family Health survey (NFHS)-3 (2006) and RSoC-2014, surveys has shown anemia and BMI status of women's of Uttar Pradesh.

Table 1.7 Anemia and BMI status of woman's of Uttar Pradesh:

Age Group	Anemia %	BMI		
		Low	Normal	High
Adolescent girls (15-18)*	48.6	38.7	61.7	1.6
Women's (15-49) **	49.9	36	54.8	1.7
Pregnant women's (15-49) **	52.4	----	----	----

Source: * RSoC, 2014, ** NFHS-3, 2006

1.4. Local availabilities of food in U.P. state:

Uttar Pradesh is the largest state of the India in terms of population and second largest in area in the country. Agriculture is the major livelihood activity of majority of rural population in Uttar Pradesh. The state is the largest food grains (millets), vegetables, tropical fruits and milk producing state, therefore, a verity of foods from all food groups are locally available in almost all zone. Sustained growth in agricultural production and productivity is essential for over all sustainability of the state economy. In India, agriculture sector of Uttar Pradesh has an important segment for national economy in general and economy in particular (Gulati, 2012).

Case study report for possibility of Diet Diversity and availability of food: Information related to agriculture produce and its utilization has been collected for assessment of the possibility of Diet Diversity, availability of food in HH and local market.

Used questionnaire for measuring HHDD Score: Food and Agriculture Organization of the United Nations (FAO*, 2010)*

A. District: Banda, Sub-district- Attarra, Village- Lodhaura (total surveyed HHs 10)

(I)Agriculture produce and Human consumption: It has been observed after study of agricultural production of HHs, that people consume very less amount of small grains for human consumption. Either they sell out those grains or use for animal feed even its price is also very less than wheat and rice.

Table 1.8 Total agriculture produce and its utilization (village -Lodhaura):

Name of Produce	Total Agri. Produce per year in Kgs	Human Consumption by HH per year in Kgs	% of Human Consumption per year	Consumption Frequency
Wheat	5900	4400	61.53	2/Per day
Bajara	**725**	**40**	**5.51**	**5/year**
Jwar	**350**	**18**	**5.14**	**8/year**
Potato	800	650	81.25	24/month
maize	**280**	**34**	**12.14**	**30/ year**
Mustard	190	170	89.47	20/ month
Bengal gram	110	80	72.72	4/ month
Paddy	250	250	100.00	1/Per day
Red gram	25	20	80.00	6/month

(II) Household Diet Diversity score: The selected house hold have low 20% and medium 80% of DD score but high DD score have not found in any households.

B. District- Kannauj, Sub-District- Tirwa, Village- Rampur (total surveyed HHs 10)

Agriculture produce and Human consumption: It has been observed after study of agricultural production of HHs, that people consume very less amount of small grains for human consumption. Either they sell out those grains or use for animal feed even its price is also very less than wheat and rice.

Table 1.9 Total agriculture produce and its utilization (village Rampur):

Name of Produce	**Total Agri. Produce/ year in Kgs**	**Human Consumption by HH/ year Kgs**	**% of Human Consumption/ year**	**Consumption Frequency**
Maize	**8080**	**200**	**2.47**	**35/ year**
Potato	4400	1800	40.90	28/ month
Wheat	2400	1100	45.83	2/Per day
Onion	2000	300	15.00	20/ month
Bajra	**1000**	**10**	**1.00**	**5/ year**
Mustard	400	300	75	20/ month

(II) Household Diet Diversity score: The selected house hold have low 33% and medium 66% of DD score but high DD score have not found in any households.

Jwar, Bajada, Ragi and other small grains are rich in Calcium, Iron, zinc and other minerals but often people don't take even they cultivate these grains.

Table 1.10 Nutritive value of row food stuff:

Name of food stuff	Protein (g)	Minerals (g)	Calcium (mg)	Iron (mg)	Phosphorous (mg)	Carotene (μg)	Energy (kcal)
Bajara	11.6	2.3	42	8.0	296	132	361
Wheat (whole)	11.8	1.5	40	5.3	306	64	346
Paddy (raw)	7.5	0.9	10	3.2	190	0	346

Farmers produce many crops which are also rich in nutrients like mustered and pumpkin. If they use mustered leaves, they do not need to crop other vegetable to full fill their nutritional requirement. There is a huge scope around people but they need to search those so that they could use these opportunities in their lifestyle to improve and enhance their nutritional requirements.

In agriculture scenario of Utter Pradesh state of India, the possibility of dietary diversity may be achieve a maximum among the people is a hypothetical phenomenon. Ignorance about diet in low cost, unhygienic cooking and storage practices with house hold environment etc. are variables associated with present poor health scenario of rural community. **Therefore, diet diversity must be planned at local level with other preventive nutritional approaches, which will be able to improve the nutritional status of every group of the population.**

1.5 Diversity in Diet:

A diet which is sufficiently diverse may reflect nutrient adequacy, "Dietary diversity (DD) is universally recognized as a key component of healthy diets. It is defined as the number of different foods or food groups consumed over a given reference period" (Ruel, 2002).

Individual dietary diversity scores aim to reflect nutrient adequacy. Studies in different age groups have shown that an increase in individual dietary diversity score is related to increased nutrient adequacy of the diet. Dietary diversity scores have been validated for several age/sex groups as proxy measures for macro and/ or micronutrient adequacy of the diet. Scores have been positively correlated with adequate micronutrient density of complementary foods for infants and young children, and macronutrient and micronutrient adequacy of the diet for non breast-feed children, adolescents and adults (WHO, 1996/FAO, 2010).

All people need a variety of foods to meet requirements for essential nutrients, and the value of a diverse diet has long been recognized. Lack of diversity is a particularly severe problem among the populations in the developing world, where diets are based predominantly on starchy staples and often include few or no animal products and only seasonal fruits and vegetables. For vulnerable infants and young children, the problem is particularly critical because they need energy- and micro nutrient-dense foods to grow and develop both physically and mentally and to live a healthy life.

1.6. Justification of study:

The developmental policies of any nation have been aimed at improving the quality of life of all citizens by providing them health and safe foods at affordable cost as well as empowered them for productivity. India has moved from food grain production sufficient to meet the recommended normal kilo calories requirement of our population. In spite of striking agricultural progress, poor nutrition and poverty; induced under and malnutrition are wide spread in India especially in Utter Pradesh. On other hand the changing and existing dietary pattern of the population with stressful life have posses different health problems such as diabetes, cardio-vascular diseases, Gastro Intestinal track (GIT) problems etc. The formulation and manufacturing of nutritious, enriched, health promoting foods at affordable cost is only a solution of both health and nutritional problems with promotion of dietary -diversity. "**This is also a prime demand to proper security and utilization of agricultural produces"** (Word Bank, 2012).

"The importance of food-based approaches for the prevention and control of micronutrient deficiencies as well as for the improvement of nutrition in general Diet Diversity is fully recognized'' (FAO, 2010). Consequently, there is increasing emphasis on food-based approaches: fortification, dietary diversification and modification, and bio-fortification. These are all designed to supply micronutrient without any changes in feeding practices (food habits), and irrespective of the amount of food consumed by the people (Chandrasekhar et al., 2015). **There is a need to formulate the diversified diet with improved nutritional quality and promote the people at household level for its adoption**.

1.7. Statement of the problem:

Keeping above in view, the present attempt is made and planned on **"Improving Nutritional Value of Diet by Introducing Diet Diversity through Local Nutritional Solution in Rural**

Households" aimed at an assessment of socio-economic and nutritional status, find the responsible factor for low DD and poor nutrition of households as first phase. Second phase of study will be formulate a nutritional solution package based on diet diversity and its implemented for 180 days programme. In the Third phase of study evaluate the impact of intervention will be done in **third phase of study**.

1.8. Operational definitions:

(I) Rural Households: Rural areas house hold will be selected as rural house hold in present study.

Rural areas are also known as country side or villages. It has a low density of population.

The National sample survey Organization (NSSO) Define rural as follows:

- An area with a population density of up to 400per kilometer squire.
- Villages with clear surveyed boundaries but no municipal board.
- A minimum of 75% of male working population involve in Agriculture and allied activities.

(II) Nutritive value of diet: Present of essential nutrients in appropriate amount make good nutritive value of diet.

(III) Nutritional solution: Formulation of "Nutrition Solution" based on dietary diversity for HHs to improve their nutritive value of diet through adequate diet adaptation. These diets will be suggested with the promotion of intake of diversified diet and functional food ingredients therefore have a potential to encompass preventive, promotive as well as curative dietary approach for ensuring healthy life. This will be an integral and creative segment of the present study.

(IV) Dietary Diversity (DD): Dietary Diversity is defined as the number of different foods or food groups consumed over a given reference period.

(V) Diet Diversity score: Dietary diversity score is usually measured by summing the number of foods or food groups consumed over a reference period.

1.9. OBJECTIVE

The following main objectives have been developed for the study:

1. To assess the demographic and socio-economic information from the selected households.
2. To assess the nutritional status including diet pattern and food practices prevalent in selected households.
3. To assess the food availability for selected households.
4. To formulate a suitable nutritional solution by including Dietary Diversity for improvement for selected households.
5. To implement and observe the "Nutritional Solution" among the households.
6. To evaluate the impact of "Nutritional Solution" in the households.

1.10. Variables:

(I) Dependent Variables:

- Dietary pattern
- Dietary practices and food habits
- Process of cooking
- Food Storage practices
- Variety of food intake
- Food security
- Individual intake
- Diet Diversity Score

(II) Independent Variables:

- Age

- Occupation
- Economic status
- Social status
- Educational status
- Marital status
- Family Size
- Type of family
- Physiological status
- Type of activity

1.11. Expected / deliverable outcome:

This research will provide a wide range of ideas and thoughts in concerning area, because the study will provide information regarding the etiological facts behind existing nutritional status of HHs in one hand such as the prevalent food practices, foods fads, awareness status and hygienic environment of HHs etc. On other hand the study will formulate a suitable nutritional intervention solution including its impact assessment. The success of this study will be an ideal to mapping the large scale community nutrition programms by policy makers.

2.0 REVIEW OF LITERATURE

Several authors therefore argue that, quality of diets is directly correlated to dietary diversity and inversely related to malnutrition , a large number of studies seem to be focusing on determinants of dietary energy consumption (or dietary quantity), at the expense of dietary quality and diversity.

Table 2.1 Details of review literature:

Studies based on	SN	Year	Name of the Researcher	Title	Results
1. Agriculture and malnutrition in India	1	2012	Gulati et al.	Agriculture and malnutrition in India	The correlations between the Combined Normalized Malnutrition Index (CNMI) and factors that could affect malnutrition among adults and children are reported. Agricultural performance and income measures (GVOAL/ha and PCGSDPA) show high and significantly negative correlations with CNMI. Other variables that have a strong influence on CNMI include women's literacy, the presence of a toilet in the home, and healthcare variables for both women and children. Unexpectedly, the indicator of access to improved sources of drinking water has a low and non significant correlation with CNMI.

	2	2014	Chauhan et al.	Diversity of leafy vegetables used by tribal peoples of Chhattisgarh	The study on identification and documentation of leafy vegetable revealed that the tribal and local population living in remote areas. Often do very little cultivation; they ate a variety of leafy vegetables. The 51 such leafy vegetables that were eaten by the tribal and local people of Chhattisgarh are described in this study .The information was based on an ethno-botanical field study of the different parts of Durg dist. The study showed that; a large amount of cultivated leafy vegetables as well as weed plants used as vegetable of Durg region are having an edible and nutritional values.
2.Assessment of nutritional status	3	2015	Kumarakuru et al.	Assessment of nutritional status and dietary pattern of adolescents in coastal area of Punduchery	This study assessed the nutrition status and dietary pattern of adolescent of both gender age groups. Height and weight are measured and dietary intake was recorded by 24 hour recall method. The mean intake of food stuff of fats and oil, green leafy vegetable, root and tuber, fruit and was gruesomely inadequate varying only 28.7, 24.7, 12.3 and 34.3 per cent respectively of the suggested RDA allowances. Pulses and other vegetable were adequate meeting the allowances. The study revealed

					prevalence of under nutrition and decrease energy intake along with low micronutrient intake among the adolescent. The prevalence of stunting among adolescent boys and girl of fishing community was 55.5 and 63.8 per cent an thickness was 38.3 and 29.8 per cent respectively. The result of the study revealed inadequate intake of food by the adolescent which is expected as hidden hunger. The protein calorie inadequacy and the prevalence of stunting data strongly highlights the requirement of awareness programs for the adolescent in fishing community on important of balanced diet and good nutrition practices to improve the nutritional status of the adolescent.
3.Determinants of Dietary Diversity	4	2014	Das, M.	Measures, Spatial Profile and Determinants of Dietary Diversity: Evidence from India	This paper using nationally representative dataset from India, analyzes the determinants of dietary diversity, which is measured using the Entropy Index. Heterogeneous dietary diversity profile across adjoining regions highlights the persistence of uneven development in terms of consumption and health indicators. Quartile regression analysis is used to identify the impact

					of determinants at different parts of the intake distribution. We find that level of consumption expenditure, quality adjusted prices of food items, and educational attainment and information dissemination are important factors that affect the household's consumption of a diverse diet. As one moves away from towns dietary diversity improves. Large size landholders need not necessarily consume a diverse diet as expected. Suitable policy interventions are identified.
	5	2004	Arimond et al.	Dietary Diversity Is Associated with Child Nutritional Status Evidence from Demographic and Health Surveys	This analysis of Demographic and Health Surveys (DHS) data confirms that dietary diversity is generally associated with child nutritional status, and that the associations remain when household wealth and welfare factors are controlled for by multivariate analyses. This was observed for a range of countries and populations with widely Different dietary patterns. Dietary diversity was significant as a main effect in 7 countries in multivariate models, and interacted.
4.**Food & Nutrition**	6	2015	Shetty et al.	From food security to	The need for a paradigm shift in policy formulation from focusing on food security at

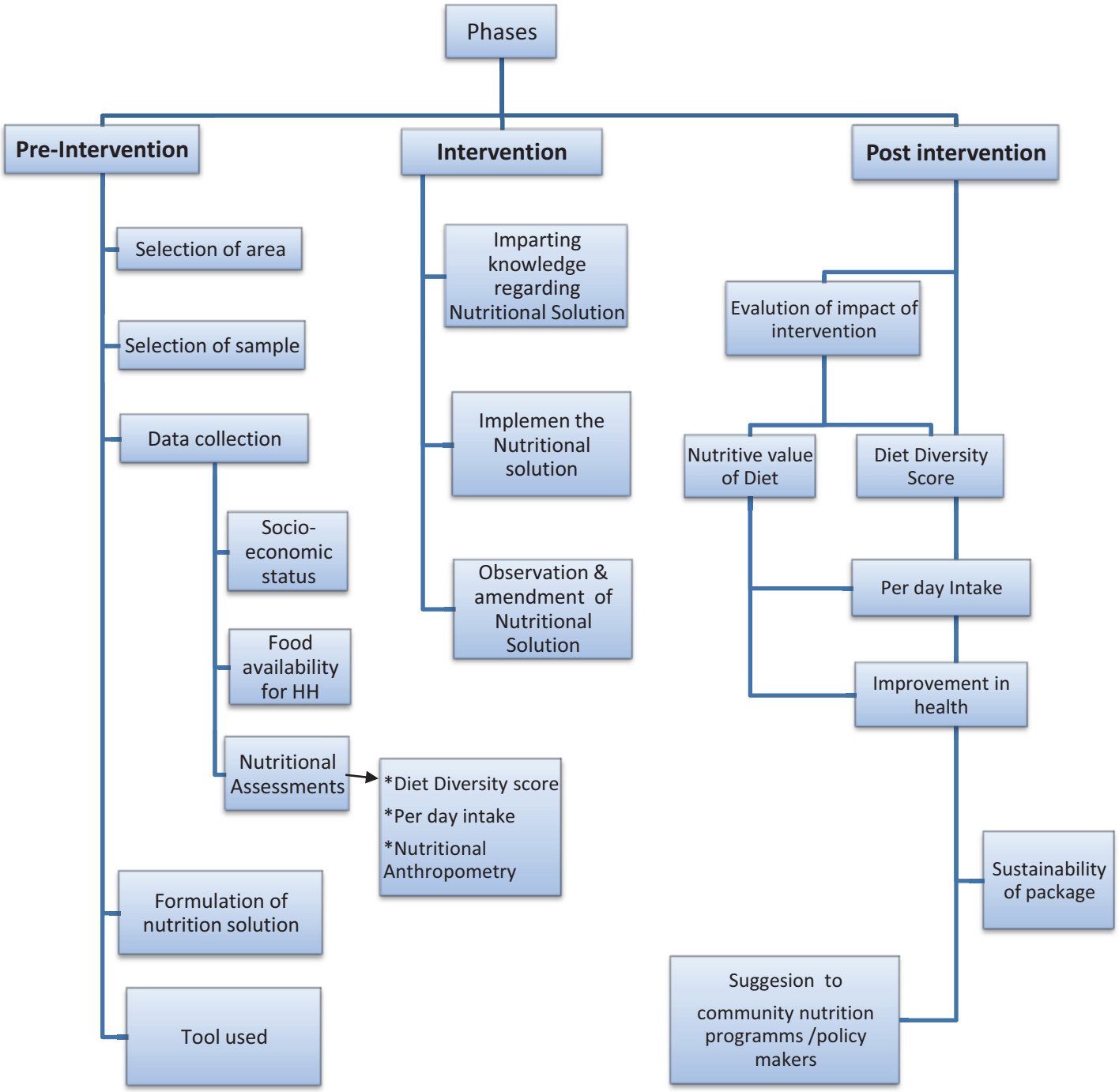
security				food and nutrition security: role of agriculture and farming systems for nutrition	the aggregate level to nutrition security at the level of each child and adult implied that the definition 'food and nutrition security' integrates both the conceptual frame works of food security and nutrition security. This integrated approach aspires not merely to address the micronutrient malnutrition which is a bigger problem than food energy deficiency, but is a food based approach that also tackles non-food factors such as water, sanitation and care practices.
	7	2015	Chandrasekhar et al.	Pathways from Agriculture to Nutrition: Implications of the Occupation Structure in Rural India	The basic premise of this paper is that while food security at the macro level is of paramount importance, from a micro (household) perspective there cannot be an excessive reliance on agriculture as a source of food and income to facilitate improvements in dietary diversity and nutritional intake of rural households.
	8	2006	Ruel, T.	Operationalizing Dietary Diversity: A Review of Measurement	This review documents experience with the measurement of dietary diversity in developing countries. It emphasizes the need to pursue efforts to improve measurement approaches, to assess dietary diversity and to carry out

				Issues and Research Priorities	validation studies to test the usefulness of diversity indicators for different purposes. Evidence from a 10-country analysis shows a strong association between household-level dietary diversity and per capita consumption and energy availability, suggesting that dietary diversity could be a useful indicator of food security (defined in terms of energy availability). A few additional studies also confirm the association between household dietary diversity and socio-economic status in other contexts.

3.0. RESEARCH METHODOLOGY

The study will be conducted in following phases

Figure 3.1 Phases of study:



Methodology used to achieve the objectives of the study is discussed in the following section.

Pre-Intervention phase

3.1 Sampling Design and Techniques:

The national sample survey organization (NSSO), adopts a multistage stratified random sampling method.

The present study will be carried out on total 8 villages from 2 selected Districts. 50 HHs will be selected from each selected District. Total 100 HHs will be selected in this study.

Figure.3.1.2 Area of sample selection:

A. Selection of Districts: District Banda and Manipuri are purposively selected from different agro climatic zone; in the different agro-climatic zone have different type of crop and possibility of diet diversity.

(I) Kannauj: District has 209000 ha total area out of which 166000 ha is under cultivation. Soils are deep and sandy loam to silt in texture. Paddy, maize, wheat, mustard and potato are major crops of the district. In Kannauj of the 95 percent is irrigated and 5 percent is unirrigated. It is a well established fact that irrigation is an important determinant of choice of crops grown by the farmer, the extent of intercropping and mixed cropping.

(II) Banda: In Banda of the 343,438.03 hectares, 50.40 percent is irrigated and 49.60 percent is unirrigated. It is a well established fact that irrigation is an important determinant of choice of crops grown by the farmer, the extent of intercropping and mixed cropping**.**

B. Selection of Sub-District: In each of the selected district two sub-districts randomly selected.

C. Selection of Villages: From each selected sub-districts, 2 villages will be randomly selected for the purpose of survey. Thus, total of 4 villages will be selected for the study in each district.

Table: 3.1.1 Area of Sample selection:

District	Banda				Kannauj			
Sub-district	Atarra		Baberu		Tirrva		Chhibaramau	
Village	Village 1	Village 2	Village 1	Village 2	Village 1	Village 2	Village 1	Village 2

D. Selection of households (HHs): Each selected sub-district 2 census villages will be selected. Requires number of household for the survey in each village is in proportion to the population of the village, with the help of Enumeration Schedule (schedule no.2). Total of the HHs will be investigated by randomly selecting the first HH.

Required number of households for the survey in each village is in proportion to the population of the village

3.2 Criteria for selection of household:

- Before survey of the selected HH it will be made sure that the respondent have sufficient time and are willing to give all information. If the responded is not willing to give all information, in this case another alternate household will be selected for study.
- 24 hours dietary recall information can only take from those who have prepared the food last day. For diet recall the cook of the family have to give her one hour for complete information for this the work (the lady) will be given refreshment. If the lady is not ready to co-operate with us then in that case alternate HHs will be selected.
- At least 50% of the family members must be present in the HHs for anthropometry assessment.
- Alternate household will be selected near the previous selected household

3.3. Operational design:

Operational design includes the techniques by which the work is carried out. Preparation of the tools for the research will be an important step because the data selected to study the, knowledge and practices of the respondent will be based on the efficiency of the tools**.**

3.3.1 Tools: A structure schedule that comprised of seven set elicit the information on as started under, will be formulated to elicit the information from of the respondent.

Table 3.3.1.1 Detail information's about of Tools:

Schedule No.	**Data collection Technique**	**Preparations of questioner/ schedule**	**Nature of information for data collection**
1	Group Discussion Schedule	Self made	Base line information: o Information related to cropping pattern o Food availability in the village o Generally food practices prevalence in the

			community
2	Enumeration Schedule	Modify Questionnaire of NNMB	○ Generate the HHs number ○ Name of the Head of family ○ Occupation of head of HHs
3	Household Schedule (Demographic and socio-economic status)	Modify Questionnaire of NNMB	Demographic information of selected HHs ○ Identity and GPS location of the HHs ○ Informed consent and signature of respondent ○ Family size ○ Name of family members ○ Date of birth and age ○ Relation to head ○ Physiological status ○ Disabilities Socio-economic information of selected HHs ○ Educational status ○ Major occupation ○ Type of activity ○ Annual income ○ Household condition ○ Cast and religion
4	Availability of food for household and knowledge	Modify Questionnaire of NNMB	○ Agriculture Produce and its utilization ○ Home state production and its utilization ○ Other Source of food and its utilization ○ Availability of food in local market/village

	related to dietary practices (schedule/questionnaire)		○ Frequency of consumption of food in HHs ○ Quantity of food intake in HHs ○ Traditional Practices of household ○ Hygiene and sanitation ○ Discrimination of food in male and female
5	Dietary Intake (questionnaire/ observation)	Standardized by NNMB	Information regarding their previous day's diet ○ Meal pattern ○ Name of the preparation ○ Food stuff ○ Raw amount ○ Total cooked quantity ○ Individual intake ○ Left Over of food and its utilization ○ Outside food intake ○ Consumption Unit (CU)
6	Nutritional Anthropometric Schedule	Modify Questionnaire of NNMB	○ Measurement of height ○ Weight ○ Body Mass Index (BMI) ○ Mid Upper-arm Circumference **(**MUAC)

3.3.2. Procedure of the study:

3.3.2.1 Data collection:

The collection of data will be made on the following methods:

(I) Group Discussion (Base line Information): Information related to cropping pattern, food availability in the village and generally food practices prevalence in the community will be collected. Before surveying the village, it will be sure that the villages have fulfilling the criteria of village selection.

(II) Enumeration of HHs: Generate HHs number, name of the head of family, occupation of head of HHs; it will be procedure for selection of HHs for study in the selected village.

(III) Household Particulars: Demographic and socio-economic particulars such as identity and GPS (Global Positioning System) location of the HHs, informed consent, family size, name of family members, date of birth and age, relation to head, physiological status' disabilities, socio-economic information of selected HHs, educational status, major occupation, type of activity, annual income of all the individuals, in each of the selected HHs, information about household condition etc. will be collected from all the 100 selected households by administering a developed proformae.

(IV) Availability of food for household and knowledge related to dietary practices : The information will be collected related to agriculture produce and its utilization, home state production and its utilization, other source of food and its utilization, lowest and highest level of stocks in this year, In the last 12 months, a situation when the, HH did not have enough food to feed, Availability of food in local market/village, traditional practices of household, hygiene and sanitation, discrimination of food in male and female. Information related to food frequency of selected HH will be carried out by food frequency table, standardized by NNMB.

(IIV) Dietary Intake: Elicit factual information regarding their previous day of all the individuals will be carried out by, 24-hour recall method and observation of cooking practices in terms of

methods and maintenance of hygienic condition covered for nutrition assessment. NNMB diet survey schedule, use for 24 hour recall.

(V) Anthropometric Assessment: Anthropometric measurements such as age, height, weight, mid-upper arm circumference and BMI for adults will be taken by using standard equipment and procedures in measurement schedule.

3.3.2.2 Formulation of "Nutritional Solution": The study encompasses the exploratory research design combine with formulation of "Nutrition Solution" based on dietary diversity to improve nutritional value of diet for their normal health as well as reducing the risk of malnutrition, infection and other metabolic diseases through adequate diet adaptation. These diets will be suggested with the promotion of intake of diversified diet and functional food ingredients therefore have a potential to encompass preventive, promotive as well as curative dietary approach for ensuring healthy life. This will be an integral and creative segment of the present study. The content and channels of this package will be determined after the assessment of actual nutritional needs of HHs with assessment of their awareness status and grasping level, in the first phase of the study as pre-test.

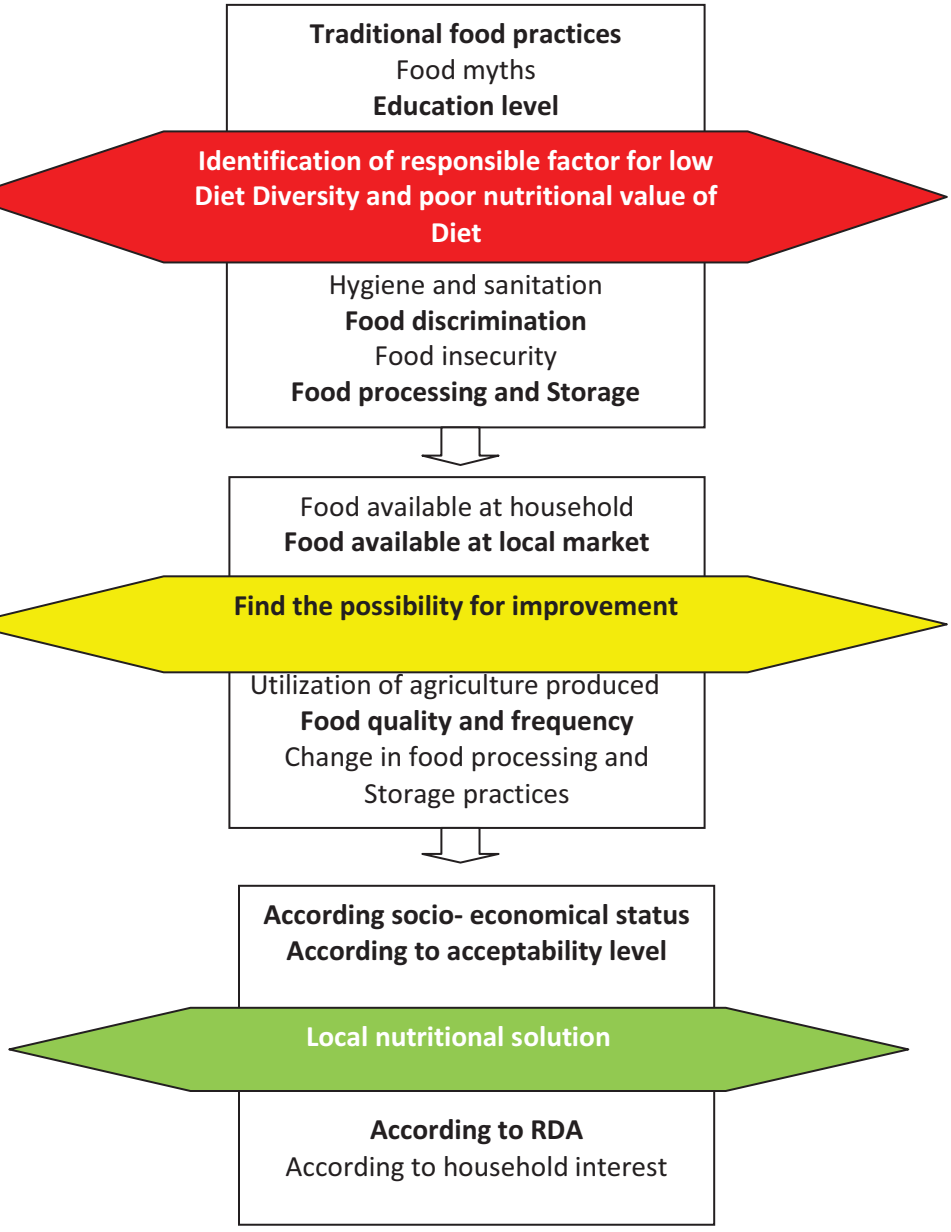
These things may be in nutritional solution package for increasing DD score and nutritional value of diet:

- To change in quantity and frequency of food stuff used in household.
- To change in food processing and storage practices of household.
- Change in eating habits and hygienic practices.
- To promote the eatable part of crop for human consumption, those produce in agriculture.
- Suggested some recipes as pr household interest, so that their interests increase in food.
- To spread awareness related to food myths, food discrimination between male and female, and general education of nutritional.

- To promote purchasing of good nutritious food available in the local market.

If there are other possibility of nutritional improvement, will be included it.

Figure.3.3.2.2.1 Formulation of "Nutritional Solution"


Traditional food practices
Food myths
Education level
Identification of responsible factor for low Diet Diversity and poor nutritional value of Diet
Hygiene and sanitation
Food discrimination
Food insecurity
Food processing and Storage
Food available at household
Food available at local market
Find the possibility for improvement
Utilization of agriculture produced
Food quality and frequency
Change in food processing and Storage practices
According socio- economical status
According to acceptability level
Local nutritional solution
According to RDA
According to household interest

Intervention Phase

3.3.2.3. Implementation of "Nutritional Solution": The formulated programme will be implemented for 180 days in each field. Before implementation of "Nutritional Solution", spread awareness related to food myths, food discrimination between male and female, and general education of nutritional two day's nutritional educational program will be conducted. During implementation period dietary intake of selected HH will be observed and amendment in fix interval (15days), and solve out the problem related to "Nutritional solution", like issue related to availability of food issue related to preparation of the food and issue related to intake of food.

Post Intervention Phase

3.3.2.4. Evaluate the impact of programme: This will be estimated by developed questionnaire/ schedule (Schedule No. 4, 5 and 6) in pre- post test method**.** An investigation will also be made on dietary improvement **(**individual dietary intake) status of selected age groups from every HHs with observation on the follow-up the suggestions given during programme.

For assessment of sustainability of "Nutritional Solution" will be cheeked according to DD score and Nutritive value of diet.

3.3.2.5. Data analysis: After collection of data the standardized values, classifications etc, will be used and compare for obtaining the results and suitable statistical methods and tools will be used to analysis of actual data to revealing the findings of the study. The dietary adequacy will be determined by compare the data with their recommended dietary allowances suggested by ICMR. The dietary scores will be ranked by standard classes given by W.H.O.

3.3. Statistical design:

In the present study following statistical techniques were used for analysis.

(A) **Arithmetic Mean:** the arithmetic mean is the sum of score divided by the number of respondent.

$$A.M. = \frac{\sum X}{N}$$

A.M. = Arithmetic mean, $\sum X$= Sum of scores, n= number of respondent

Uses: To assess the mean responses of the group of various parameters of the study**.**

(B) **Percentage**: Comparison where made on the basis of the percentage. The frequency of a particular cell will be multiply by 100 and divide by total number of respondent in that particular category to wich they belong.

$$P = \frac{\text{nX100}}{N}$$

P=percentage, n= obtained score, N= total or maximum score

Uses: To study the distribution of the sample.

(C) **Standard Deviation**: it is usually denoted by letter σ (small sigma) of Greek alphabet and is a measure of dispersion. Standard deviation is the square root mean of the square of given observation from their mean.

$$\text{S.D.} = \frac{\sqrt{\sum(X-\mu)2}}{N}$$

S.D. = standard deviation, x= an observation or variant value, n= total number of observation, ∑= sum of total

Uses: it will be used in computing different statistical quantities.

Further Statistical technique will be applied as per nature of data obtained.

4. ETHICAL CONSIDERATIONS

A. Permission from responsible authority:

Before performing the survey it must be make sure from 'Gram Pradhan' and other responsible people that I am caring out the survey; if they do not permit then survey will be done in other village of that district.

B. Concern with respondent:

Information browser (Study purpose, the potential harms and benefits) and concern form will be also prepared for participant.

Before assessment and collecting information it will be make sure that the HH that are selected are able to give us proper information are willing to give information. For anthropometric, at 50% the family member must agree, and if this is not done then another alternate HH will be selected.

5. DELIMITATION

- This study is done only in rural HHs of Uttar Pradesh in Banda and Kannauj District.
- Only 100 HHs will be selected for the study, per district 50 HHs will be selected.
- In this study children bellow 2 years will not be taken.
- In anthropometry only height, weight, BMI, MUAC will be done.
- The "Nutritional Solution" (base on local availability of food) will be prepared for only selected households.
- In this study will be formulate a "Nutritional Solution" at household level.

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